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CORRELATION AND PATH COEFFICIENT ANALYSIS OF YIELD COMPONENT AND FIBER QUALITY TRAITS OF UPLAND COTTON (*GOSSYPIUM HIRSUTUM* L.)

CHANDRASHEKHAR, ANGADI[1], MANJULA, S. M[2], PATIL, S. S[3], MADHURA, C[4], BASAVARADDER, A. B[5] & SANTOSH, H. B[6]

[1,4,5]*Department of Genetics and Plant Breeding, UAS, Dharwad, Karnataka, India*

[2,3]*AICRP on Cotton, ARS, UAS, Dharwad, Karnataka, India*

[6]*Division of Crop Improvement,CICR,Nagpur, Maharashtra, India*

ABSTRACT

Phenotypic correlation and path coefficient analysis have been worked out for yield and fiber quality traits in 173 RILs of Gossypium hirsutum L. cotton at Agricultural Research Station, Dharwad, UAS, Dharwad. Number of bolls per plant, boll weight, 2.5% span length and micronaire value were found to be positively correlated with seed cotton yield while days to 50 per cent flowering shown negative correlation. Further partitioning of correlation coefficients into direct and indirect path ways of influences showed that the characters having most influence on seed cotton yield are boll weight and number of bolls per plant, which can be considered while selecting for higher yields.

KEYWORDS: Upland Cotton, Recombinant Inbred Lines and Fiber Strength

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Original Article

INTRODUCTION

Cotton is an important cash crop of the India. It plays a key role in the national economy in terms of its contribution to trade, industrial activities, employment and foreign exchange earnings (Gite *et al.*, 2006). Cotton accounts 45% of world's fiber and supplies 10% of world's edible oil (Rathore, 2005). Nevertheless, the need for further amplified efforts for continued genetic improvement of cotton is even greater today than before in the face of low lint productivity. In India, the net cotton area during 2011-12 was121.78 lakh ha with production and productivity of 367 lakh bales and 493 kg lint per ha (Cotton Advisory Board, 2013) as against the world average area, production and productivity of 357.1 lakh ha, 1236.4 lakh bales and 754 kg lint per ha respectively.

Cotton improvement programmes across the world have always responded to the needs of the growers and industry and strived to combine high yield and good fiber quality. In India, development of high yielding cotton varieties with superior fiber quality is a fundamental objective of many cotton improvement programme. Hence the objective of the present study is to explore the association between various yield and fiber quality traits to facilitate indirect selection in cotton.

Yield of cotton crop depends on many traits such as plant height, number of sympodia, number of bolls per plant, boll weight, seed index, GOT etc. Lint yield and fibre quality are genetically controlled by multi-factorial polygenes or Quantitative Trait Loci (QTL). It is highly desirable for a cotton breeder to know

the degree and direction of relationship that exists between yield and its various components which will facilitate in selecting plants of desirable characteristics. This knowledge about the genetic associations among various yield components can be exploited for the development of high yielding cotton varieties through effective breeding programmes (Falconer, 1975). It is therefore, necessary to determine the relationship between yield and quality characters or between the various factors contributing to seed cotton and lint yield.

Correlation coefficients determine simple relations among the traits, but it doesn't always determine the decisive results about determination of plant selection criteria (Cakmakci *et al.*, 1998). However, Path coefficient analysis provides an effective means of partitioning correlation coefficients into unidirectional path ways and alternate pathways thus, permitting a critical examination of specific factors that cause a given correlation. Path coefficient analysis has been extensively employed in formulating an effective selection programme in cotton breeding (Larik *et al.*, 1999, Murthy, 1999 and Sultan *et al.*, 1999).

MATERIALS AND METHODS

- ***Genetic Material and Experimental Site***

RS-2013 is a well adapted genotype with biotic stress tolerance and P-56-4 is a genotype with very high fiber strength (27.8 g/tex). P-56-4 used as female parent and RS-2013 used as male parent and crossing was done by hand emasculation and pollination method. Recombinant inbred lines (RILs) were produced following Single seed descent method. One hundred seventy three RILs of intra-hirsutum cross P-56-4 × RS-2013 were evaluated in Alpha design with two replications along with 'Sahana' as check variety during 2011-12 *Kharif* season at ARS Dharwad Farm, UAS Dharwad. The seeds were hand dibbled in two rows with spacing of 90 cm between rows and 20 cm between plants within rows. All agronomic and plant protection measures were undertaken to raise a healthy crop.

- ***Observations Recorded***

Observations were recorded on five randomly selected plants for yield attributing traits such as plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), seed cotton yield (q ha^{-1}), seed index (g), lint index (g), ginning out turn (%), days to 50% flower opening, days to boll opening and . Data were also recorded on fiber quality traits such as 2.5 per cent span length (mm), micronaire value (µg/inch), fiber strength (g/tex), uniformity ratio (%), maturity coefficient and elongation (%).

- ***Statistical Analysis***

Simple correlations among various traits were calculated using the formula given by Weber and Moorthy (1952). Path coefficient analysis (Dewey and Lu (1959) was carried out to decipher the direct and indirect effects of yield attributing and fiber quality traits on seed cotton yield.

RESULTS AND DISCUSSIONS

- ***Phenotypic Correlation***

The results of phenotypic correlation and path coefficient analysis are detailed in table 1 and table 2, respectively. Path diagram based on the phenotypic correlation is presented in Figure 1.

Days to 50 per cent flowering (-0.45) and days to boll opening (-0.58) exhibited significant negative correlation with seed cotton yield, indicating that there were genotypes in the RIL population which were early in maturing yet high

yielding. It also suggested that earliness can be achieved without any compromise in yield as reported earlier by Gite *et al*., (2006), Preetha and Raveendran (2007). Boll weight (0.29) and number of bolls per plant (0.57) revealed significant positive correlation with seed cotton yield indicating their relative importance among yield component traits. Similar observations were noted by Preetha and Raveendran (2007), Sakthi *et al*., (2007) and McCarty *et al*., (2008). 2.5% span length (0.16), maturity ratio (0.21) and micronaire value (0.26) revealed significant positive association with seed cotton yield. The results are in conformity with earlier reports of Basbag and Gencer (2007) and Sakthi *et al*., (2007).

2.5% span length exhibited significant positive correlation with fiber strength (0.48) and elongation per cent (0.18) and negative correlation with uniformity ratio (-0.60). These results conformed the findings of Tuteja *et al*. (2005) and Sakthi *et al.* (2007). Uniformity ratio showed significant positive association with micronaire value (0.33), maturity ratio (0.30) and elongation per cent (0.30) as observed earlier by Preetha and Raveendran (2007) and Sakthi *et al*. (2007). Micronaire value was significantly and positively correlated with maturity ratio (0.96) and elongation per cent (0.20), while it was negatively correlated with fiber strength (-0.31). These findings are in conformity with earlier reports of Leela *et al*. (2007).

- ***Path Coefficient Analysis***

Days to 50 per cent flowering (-0.0011), days to boll opening (-0.40) and plant height (-0.0025) showed direct negative effect on seed cotton yield. Ahuja and Dhayal (2007) also reported direct negative effect of days to 50 per cent flowering and plant height on seed cotton yield. This indicates that selection of early maturing and short statured plants helps in getting genotypes with high yield. Boll weight (0.16), number of bolls per plant (0.49) and lint index (0.28) exhibited positive direct effect on seed cotton yield. Aguado *et al*. (2008) reported direct positive effect of boll weight on seed cotton yield. Ahuja *et al*. (2006) observed direct positive effect of number of bolls per plant on seed cotton yield while, Altaher and Singh (2003) reported positive direct effect of lint index on seed cotton yield. Number of sympodia per plant (-0.03), number of monopodia per plant (-0.05), ginning out turn (-0.21) and seed index (-0.28) showed direct negative effect on seed cotton yield. Similar findings were also reported by Altaher and Singh (2003) and Duhoon (1989).

2.5 per cent span length (0.06) and micronaire value (0.37) shown direct positive effect on seed cotton yield. Reddy and Reddy (2008) reported direct positive effect of 2.5% span length and micronaire value on seed cotton yield. Fiber strength (-0.07), uniformity ratio (-0.02) and maturity ratio (-0.28) shown direct negative effect on seed cotton yield. Leela *et al.* (2007) observed direct negative effect of fiber strength on seed cotton yield and Samba Murthy and Chamundeswari (2006) observed direct negative effect of uniformity ratio on seed cotton yield. However, differences in individual traits were observed for indirect effects on seed cotton yield per plant. Highly negative direct effect on seed cotton yield per plant was observed for remaining characters.

CONCLUSIONS

Seed cotton yield being a complex polygenic character, direct selection based on these traits would not yield fruitful results without giving due importance to its genetic background. Correlation analysis helps in examining the possibility of improving yield through indirect selection of highly correlated component traits. Association analysis revealed that seed cotton yield had significant positive correlation with number of bolls per plant, boll weight, 2.5 per cent span length and micronaire value. 2.5 per cent span length exhibited significant positive correlation with fiber strength and elongation per cent. Path analysis revealed high positive direct effect of boll weight, number of bolls per plant, lint index,

2.5 per cent span length and micronaire value on seed cotton yield. Selection based on these characters would be effective in improving the seed cotton yield.

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APPENDICES

Table 1: Simple Correlation of Productivity and Fibre Quality Traits among RIL Mapping Population

	DF	DBO	BW(g)	PH(cm)	NS	NM	BPP	GOT	SI(g)	LI	2.5% SL (mm)	UR %	Micronaire value	Maturity Ratio	Tenacity (g/t)	Elongation %	SCY (q/ha)
DF	1.00	0.68**	-0.39**	-0.07	-0.19*	0.19*	-0.19*	0.06	-0.18*	-0.12	-0.16*	-0.01	-0.25**	-0.25**	-0.001	-0.19*	-0.45**
DBO		1.00	-0.32**	-0.04	-0.16*	0.26**	-0.17*	-0.03	-0.17*	-0.17*	-0.16*	-0.08	-0.32**	-0.27**	-0.01	-0.26**	-0.58**
BW(g)			1.00	0.03	0.04	-0.004	0.02	-0.08	0.48**	0.35**	0.35**	-0.08	0.15*	0.15	0.33**	0.24**	0.29*
PH(cm)				1.00	0.45**	0.09	0.14	-0.17*	-0.07	-0.18*	0.06	-0.08	-0.08	-0.07	0.14	0.07	0.05
NS					1.00	-0.11	0.13	-0.20**	0.05	-0.10	0.16*	-0.10	0.02	0.02	0.07	0.08	0.11
NM						1.00	0.17*	-0.16*	-0.01	-0.11	0.01	-0.02	-0.21**	-0.18*	0.09	-0.12	-0.09
BPP							1.00	-0.02	-0.16*	-0.14	0.08	-0.04	-0.01	-0.02	-0.07	0.05	0.57**
GOT								1.00	-0.18*	0.57*	-0.24**	0.15*	0.18*	0.19*	-0.21**	-0.06	0.02
SI(g)									1.00	0.70*	0.41**	-0.13	0.16*	0.16*	0.28**	0.18*	0.04
LI										1.00	0.17*	-0.01	0.26**	0.27**	0.08	0.10	0.06
2.5% SL (mm)											1.00	-0.60**	-0.08	-0.07	0.48**	0.18*	0.16*
UR %												1.00	0.33**	0.30**	0.04	0.30**	-0.02
Micronaire value													1.00	0.96**	-0.31**	0.20**	0.26*
Maturity Ratio														1.00	-0.31**	0.19*	0.21*
Tenacity (g/t)															1.00	0.43**	-0.07
Elongation %																1.00	0.14
SCY (q/ha)																	1.00

DF – Days to 50% flowering
DBO – Days to boll open
BW – Boll weight
PH – Plant height
NS – Number of sympodia
NM – Number of monopodia
BPP – Bolls per plant
GOT – Ginning outturn
SI – Seed index
LI – Lint index
SCY – Seed cotton yield
2.5% SL – 2.5% span length
UR – Uniformity ratio

Table 2: Direct and Indirect Effects of Different Quantitative Characters

	DF	DBO	BW(g)	PH(cm)	NS	NM	BPP	GOT	SI(g)	LI	2.5% SL (mm)	UR %	Micronaire value	Maturity Ratio	Tenacity (g/t)	Elongation %	SCY (q/ha)
DF	**-0.0011**	-0.27	-0.06	0.0002	0.01	-0.009	-0.09	-0.01	0.05	-0.03	-0.01	0.0002	-0.09	0.07	0.0001	0.004	-0.45
DBO	-0.0008	**-0.40**	-0.05	0.0001	0.01	-0.012	-0.08	0.01	0.05	-0.05	-0.01	0.001	-0.12	0.08	0.0005	0.006	-0.58
BW(g)	0.0004	0.12	**0.16**	-0.0001	-0.001	0.0002	0.01	0.02	-0.14	0.10	0.02	0.001	0.06	-0.04	-0.02	-0.005	0.28
PH(cm)	0.0001	0.01	0.004	**-0.0025**	-0.02	-0.004	0.07	0.04	0.02	-0.05	0.004	0.001	-0.03	0.02	-0.01	-0.002	0.05
NS	0.0002	0.06	0.01	-0.0012	**-0.03**	0.01	0.06	0.04	-0.01	-0.03	0.01	0.002	0.01	-0.01	-0.005	-0.002	0.11
NM	-0.0002	-0.10	-0.001	-0.0002	0.004	**-0.05**	0.08	0.03	0.002	-0.03	0.001	0.0003	-0.08	0.05	-0.006	0.003	-0.09
BPP	0.0002	0.07	0.003	-0.0004	-0.004	-0.01	**0.49**	0.004	0.05	-0.04	0.005	0.0007	0.00	0.004	0.005	-0.001	0.57
GOT	-0.0001	0.01	-0.01	0.0004	0.01	0.01	-0.01	**-0.21**	0.05	0.16	-0.01	-0.002	0.07	-0.05	0.01	0.001	0.02
SI(g)	0.0002	0.07	0.08	0.0002	-0.002	0.0002	-0.08	0.04	**-0.28**	0.20	0.02	0.002	0.06	-0.04	-0.02	-0.004	0.04
LI	0.0001	0.07	0.06	0.0005	0.003	0.005	-0.07	-0.12	-0.20	**0.28**	0.01	0.0002	0.10	-0.07	-0.005	-0.002	0.06
2.5% SL (mm)	0.0002	0.06	0.06	-0.0002	-0.005	-0.001	0.04	0.05	-0.12	0.05	**0.06**	0.010	-0.03	0.02	-0.03	-0.004	0.16
UR %	0.0000	0.03	-0.01	0.0002	0.003	0.001	-0.02	-0.03	0.04	-0.003	-0.04	**-0.02**	0.12	-0.08	-0.003	-0.006	-0.02
Micronaire value	0.0003	0.13	0.02	0.0002	-0.001	0.01	-0.01	-0.04	-0.04	0.07	-0.005	-0.005	**0.37**	-0.27	0.02	-0.004	0.26
Maturity Ratio	0.0003	0.11	0.02	0.0002	-0.001	0.01	-0.01	-0.04	-0.04	0.08	-0.004	-0.005	0.36	**-0.28**	0.02	-0.004	0.21
Tenacity (g/t)	0.0000	0.003	0.05	-0.0004	-0.003	-0.004	-0.03	0.04	-0.08	0.02	0.03	-0.0006	-0.12	0.09	**-0.07**	-0.009	-0.07
Elongation %	0.0002	0.10	0.04	-0.0002	-0.003	0.01	0.03	0.01	-0.05	0.03	0.01	-0.005	0.08	-0.05	-0.03	**-0.02**	0.14
SCY (q/ha)																	

R^2 values – 0.5997 Residual effect – 0.6327

DF – Days to 50% flowering
DBO – Days to boll open
BW – Boll weight
PH – Plant height
NS – Number of sympodia
NM – Number of monopodia
BPP – Bolls per plant
GOT – Ginning outturn
SI – Seed index
LI – Lint index
SCY – Seed cotton yield
2.5% SL – 2.5% span length
UR – Uniformity ratio

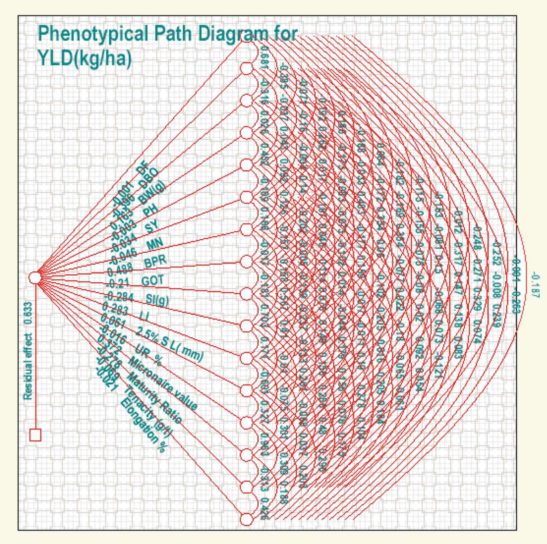

Figure 1: Phenotypical Path Diagram for Yield (kg/ha)